NOVEMBER, 1970
Whole Number 374

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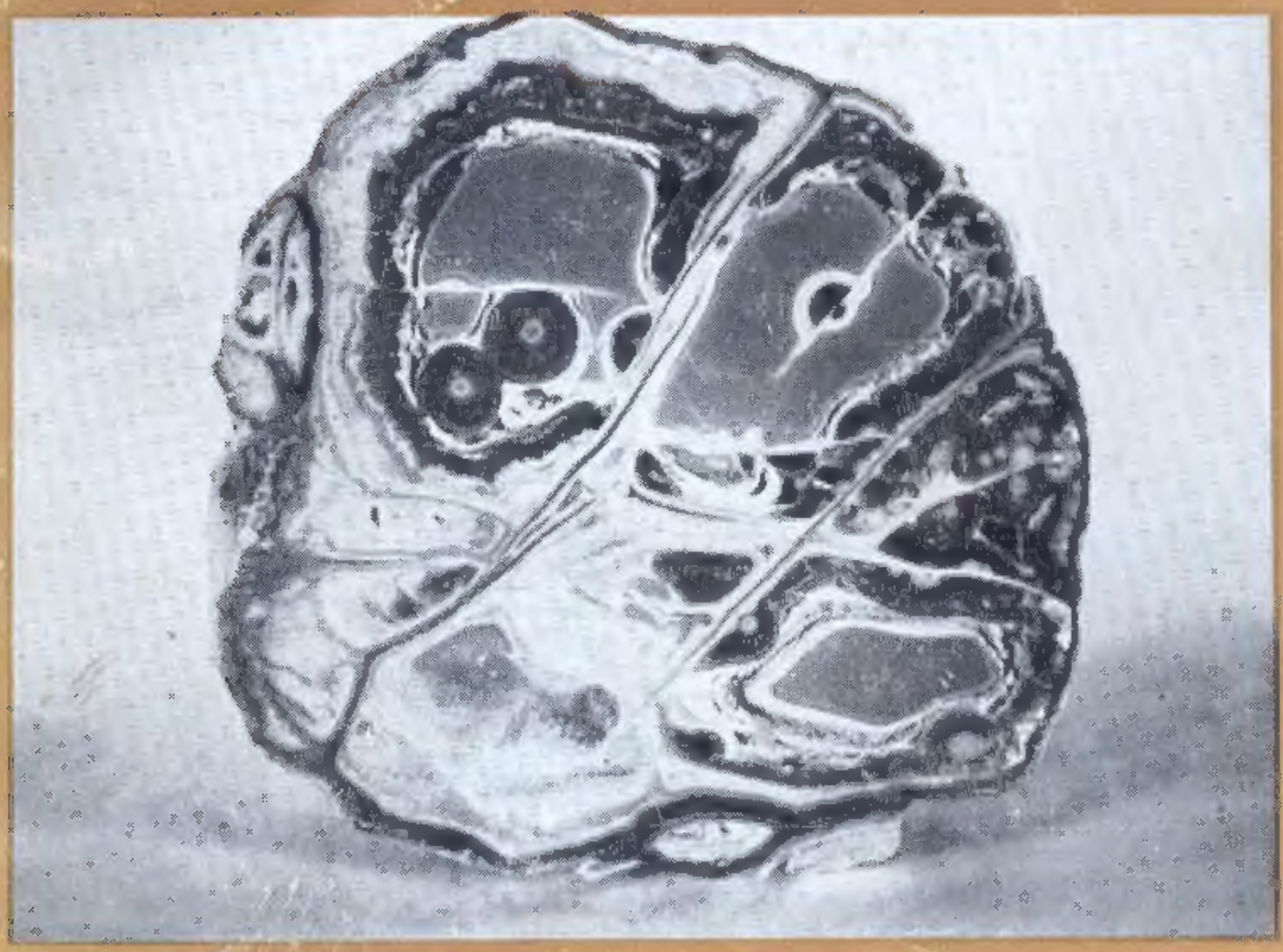
ROCKS AND MINERALS



Polished half-nodule, 4 inches across, showing deep-green variscite kernels surrounded by dark-blue wardite and yellow crandallite. From color photo by B. M. Shaub. (Lafayette College Collection)

MINERALOGY • GEOLOGY • LAPIDARY

ROCKS and MINERALS

PETER ZODAC, Founding Editor & Publisher
(1894 - 1967)

America's Oldest and Most Versatile Magazine for the Mineralogist, Geologist, Lapidary.

Published Monthly

OFFICIAL JOURNAL

ROCKS & MINERALS ASSOCIATION

Official magazine of the Eastern Federation of Mineralogical and Lapidary Societies

James and Winifred Bourne Co-Editors (Current)

WHOLE NO. 374 VOL. 45, No. 11 NOVEMBER, 1970

CONTENTS

The Phosphate Minerals of Fairfield, Utah. (Part 1) Arthur Montgomery 667
Celestite — Richard Green 676
A Slice of Life — Milton L. Leet (Mining Engineer) 683
Mineral Crystal Origin and Location Resume — William J. Furbish 718
Topaz - Birthstone for November — Mrs. Helen C. Biglin, 'Chips and Facets' 728

DEPARTMENTS

The Amateur Lapidary — Helen L. McLeod 679
The Contact Zone — Robert W. Jones 685
Current Events — Vernon Wertz 689
With Our Advertisers — James N. Bourne 698
Swapping Corner 700
Micromounters Notebook — Theodore L. Agos 702
Mineral Localities Information 708
Publications Recently Received 709
Visiting Rockhounds Welcome 724
Thumbnails — John Reiner 732

MISCELLANEOUS

Coming Events 666
Large Extinct Animals, Practically Unknown — Herman Kraege 687
New Geology Report Discusses Minnesota Clay Deposits 721
Mid-Hudson News — Gordon L. Kenney 722
7th Annual Gem & Mineral Show — Mrs. Marie Grande 730

Entered as Second-Class matter September 13, 1926, at the Post Office at Peekskill, N. Y. under the Act of March 3, 1879.
Title registered in U.S. Patent Office

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Specially written articles (as contributions) are desired.
Subscription price $4.00 a year; Current numbers 35c a copy. No responsibility is assumed for subscription paid to agents and it is best to remit direct to the Publisher.
Issued monthly on the 15th of the month.

Authors alone are responsible for statements made and opinions expressed in their respective articles.

ROCKS and MINERALS, BOX 29, PEEKSKILL, NEW YORK 10566, U.S.A.
(Office – 157 WELLS STREET) – Tele. (914) PEekskill 7-3185

THE PHOSPHATE MINERALS OF FAIRFIELD, UTAH

By ARTHUR MONTGOMERY
Lafayette College, Easton, Pa. 18042

Introduction

In the nineteen-thirties, Edwin Over, Jr., and I carried on a mineral-collecting partnership. For seven years we devoted our efforts to the collecting and mining of minerals, operating a small specimen business through which our finds could be sold. When the venture came to an end in 1940 we hadn't done much better financially than break even; but during that period we had had unique opportunities to explore and exploit many little-known and highly-productive specimen localities in the American Southwest and elsewhere. Few present-day collectors are able to enjoy that privilege. Great luck blessed our efforts and we made some notable discoveries, the results of which are to be seen in most of the world's major collections. Some of the more important finds were made at the Thomas Range, Prince of Wales Island (with C. B. Ferguson and E. P. Henderson), Mt. Antero and Fairfield. Articles on the first three have appeared in *Rocks and Minerals* (1935, 161-8; 1937, 195-208; 1938, 355-369).

The key to our successful discoveries was Ed Over's exceptional collecting abilities. One of the great mineral collectors of all time, he possessed unsurpassed keenness of eye, practical knowledge of geology, minerals and field occurrences, and expertness in small-scale mining. Professor Charles Palache of Harvard brought us together after we had individually made noteworthy specimen finds in the early thirties—Over on Mt. Antero and in the Thomas Range, and I also at the latter locality—but it was Ed who was mainly responsible for our joint accomplishments. During those years together we carried in a small car, in addition to food and camping supplies, all our needed mining equipment, including hand drill steel, dynamite and wheelbarrow, and even Ed's forge and blacksmithing tools. There were few desert or mountain areas we were unable to penetrate and explore. If we found a promising locality, we could camp there on the spot and carry on small-scale mining operations for as long as necessary. Nowadays those same places are far more accessible and apt to be overrun by hordes of collectors.

This article tells the story of our work and experiences at the variscite mine near Fairfield, Utah, and also treats those aspects of the early history and of the mineral research that are inseparably bound up with the undertaking. It is my responsibility, at the same time, to set the record straight on those matters concerning more recent ownership of the deposit which have been inexcusably distorted by a number of persons. I dedicate this account, put in print for the first time, to my old friend, Peter Zodac, whose memory does not fade among all of us who love minerals.

Discovery

In September of 1936 Ed and I returned from our mineral collecting expedition to Prince of Wales Island, Alaska. On the drive from the west coast to Colorado Springs, we went through Utah and drove out to Fairfield, fifty miles southwest of Salt Lake City, in search of the old variscite locality near there. The mine had been worked many years before for gem-quality variscite, a hydrated aluminum phosphate, somewhat resembling turquoise but deep green, rather than shades of blue. Professor Esper S. Larsen, Jr., of Harvard, good friend to so many mineral collectors of the past, had advised us to investigate the long-abandoned deposit as a possible specimen source of rare crystallized minerals. He had been there some years earlier, collected material from the waste dumps, and discovered and described a number of new species as a result of his laboratory research.

We had trouble finding the old mine, for it was hidden away in rather inaccessible hilly country a couple of miles northwest of Fairfield, a farming village clearly marked on the road map but almost unrecognizable as a center of human habitation otherwise. We finally

found the locality up a small westerly-trending canyon (*Clay Canyon,* as we found out later) which we negotiated with our car by following old tracks around clumps of sagebrush and along the bed of a sandy wash. The small mine dumps lay close to the canyon bottom on its northerly side. Close above these in the hillside loomed the square opening of a mine tunnel. There was no evidence of anyone having been there for a long time.

We lighted our carbide lamps and began an exploration of the underground workings. The tunnel, which had been blasted out of gently dipping beds of hard blocky limestone, was dry, musty and quite cool, and led straight into the hillside for a hundred feet northward. There it ended in a large high chamber, one wall of which exposed a zone of crushed and fragmented (brecciated) rock. Here the limestone had been severely broken by powerful shearing forces along a fault. Angular chunks of rusty iron-stained limestone, from small fragments up to boulder size, were embedded in a soft, powdery grayish matrix. Within the brecciated material we noted a scattering of round gray shapes something like large potatoes in appearance. These were concretionary nodules of highly altered phosphate minerals. Their interiors, when broken open, revealed porous earthy masses of whitish material we guessed to be crandallite, an aluminum phosphate known at that time as pseudowavellite. This occurrence of abundant concretions of altered phosphates suggested an obvious relationship to other nodular phosphates such as variscite. Fault zones—and we had one here—provide permeable pathways and openings for the movement and deposition of mineralizing solutions. There was not a trace of greenish variscite, however, in the earthy nodules present in this breccia zone. No wonder that the miner who drove that long tunnel had stopped here, and discontinued his search for variscite in this section of the mine.

Up on the hillside above there was a small-sized, partly caved-in pit, with adjacent waste dumps, some distance upslope from the tunnel entrance. That was probably where the first discovery of variscite had been made. Powdery brecciated rock showed in one wall of this pit and a few large brownish nodular masses of altered crandallite were partly exposed. It looked as if the tunnel had been run in such a way as to try to intersect at depth this phosphate-bearing breccia zone outcropping at the surface.

FIG. 1. Looking west up Clay Canyon (1937). Old mine dumps are close to wash. Tunnel entrance is hidden in rocks above north (right) end of dumps.

Thirty or forty feet back from the tunnel's ending at the breccia zone there was an opening into a side drift running off in an easterly direction roughly perpendicular to the trend of the tunnel. We followed that drift for about thirty feet, at which point it turned sharply northward parallel to the main tunnel. Ten or fifteen feet more and it ended abruptly in a face of earthy brownish material. The soft, broken-up appearance of the material, suggesting finely ground-up rock (gouge) along a fault, made that drift face a promising place to start digging.

We dug with sharp drift picks into that blank wall. After several hours of hard pick-and-shovel work, made more difficult by our close quarters with insufficient air and an increasingly dust-laden atmosphere, we had extended the drift face a foot or two farther to the north. All at once a pick stroke hit something, and partly exposed in the middle of the face a little brownish curving shape. It looked just like a small potato, and was a hard solid nodule. We pried it out of its earthy matrix, examined it, and noted that it felt heavy. One of us struck it with a geological hammer and broke it in two. The honeycombed interior showed a partial filling of glassy

FIG. 2. View is north from waste dumps toward tunnel entrance. Dumps below old surface pit are visible some distance above and east of tunnel opening.

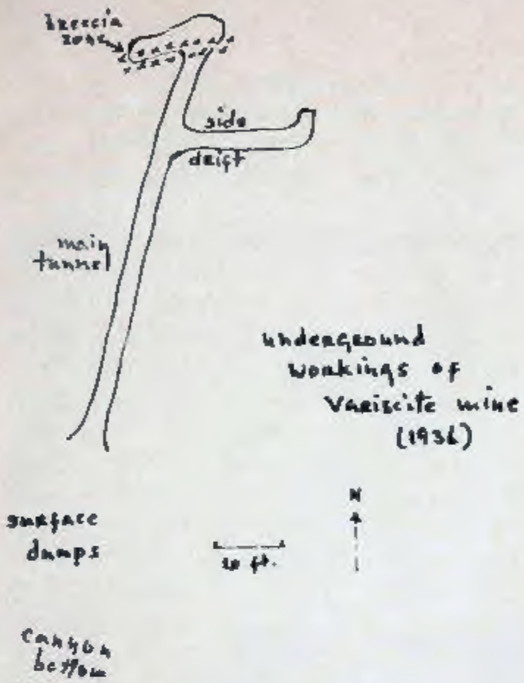


FIG. 3. Simplified sketch of underground mine workings as we found them in 1936.

pale-bluish material which sparkled with light reflected from tiny crystal faces where these lined the walls of small cavities. We had discovered a well-crystallized specimen of a quite rare phosphate mineral, wardite. It was one of the new species from this locality described by Professor Larsen. We recognized it at once by its distinctive color and the octahedral-like crystal habit. Here was a good sign, for we knew wardite to be a close associate of variscite at this locality. I had first seen the mineral displayed in Morgan Hall of the American Museum of Natural History where it stood out as bluish veinlets and small spherical eye-like shapes within two beautiful polished slabs of variscite that had come from the original mining at Fairfield. But I had never seen a distinctly crystallized specimen of the species until we had broken open that first small nodule.

Greatly encouraged by our unexpected find, we continued vigorous pick-and-shovel mining in the north face of the drift. Every once in a while we uncovered a small nodule in the soft ground-up rock material we were digging out and throwing behind us. We accumulated a good number of them during several days of work while we extended the drift, a much narrower version of it, ten or more feet farther north. Most contained nothing but powdery, whitish or yellowish crandallite; but one or two more showed wardite, and several, when split open, revealed solid cores of deep-green variscite. We were on the right track!

It was too late in our field-collecting season that year to try to commence any serious mining operation. We decided to return early the following summer. First, however, it was necessary to investigate the ownership status of the mine. We had seen no evidence of any recent work, nor any signs of markers or claim notices signifying active ownership of a mining claim. We therefore proceeded to stake out our own lode claim. We did this by using a compass and pacing off on the hillside a center line fifteen hundred feet long, more or less parallel to and continuing the trend of the main tunnel. Then we paced off three hundred feet on either side of this center line, to the west and the east, to establish intersection points through which two parallel side lines would be extended along the east and west borders of the claim. Extending the side lines to their full fifteen-hundred foot length, north and south, gave us the sites of the four claim corners at their end points. We marked these by four piles of boulders, known as stone monuments. These corners enclosed a rectangular piece of ground fifteen hundred feet long by six hundred feet wide. The mine dumps, tunnel entrance, and hillside pit all lay close to the center line of the claim. We nailed a board to a cedar tree adjacent to the tunnel entrance announcing our claim discovery and location.

Inside the tunnel, at the north end of the side drift, we had already dug out a proper discovery excavation in virgin ore-bearing rock. Mining law requires a discovery hole exposing newly-found ore to be the equivalent of ten feet deep and excavated at a minimum cost of a hundred dollars. Our period of work and extension of the drift satisfied these

requirements. We next drove to Provo, the County Seat, fifty miles distant, to look up in the Recorder's office all records of mining claims in the general area. There were no records of any recent claim locations at or near the site of the mine. We did find the older claim recordings that went back to the early nineteen-hundreds. We presumed that the most recent claimant, a Don Maguire in the early nineteen-hundreds, had been responsible for the extensive underground mining. In any case, we were perfectly free to relocate and mine the deposit. We had decided to give our lode claim, now proven valid, the rather lurid, but aptly colorful name of the Little Green Monster.

B. D. Bennion (1967) has recently written an interesting account of the early history of the mine in *The Utah Report*, a publication of the Utah Federation of Gem and Mineralogical Societies. Unfortunately, those of his data pertaining to the more recent history, in which Over and I were involved, are almost completely erroneous. The true facts, given in this article, can be easily verified by reference to the Court records in Provo covering details and resolution of the litigation over claim ownership in the nineteen-fifties. I am indebted to Howard V. Hamilton for the extensive (but incomplete) list of references on the variscite deposit given after the final installment of this article, some of which are cited in the text by including within parantheses the author's name and publication date.

History

Late in 1893 F. T. Millis of Lehi, a hamlet about twenty miles east of Fairfield, sent into the curator of minerals at the U. S. National Museum a fair-sized nodule containing a greenish unidentified phosphate. This was determined to be variscite, a mineral already known from European localities. Its beautiful color and hard massive character gave it both specimen and gem-polishing value. Small-scale mining of the surface outcrop of brecciated nodule-bearing rock, below which the first-discovered specimens must have been picked up loose, opened up the small pit on the hillside and produced a quantity of nodules. This material was partly used locally for gem-cutting, and called utahlite or amatrice (Kunz, G.F., 1895), but quite a lot of it was sold to Ward's Natural Science Establishment in Rochester, New York, during 1894 or 1895.

In 1896 a paper was published in the American Journal of Science by a University of Rochester chemist and mineralogist, J. M. Davison (1896). In it a wholly-new phosphate from Fairfield, pale greenish-blue and closely associated with variscite, was described and named wardite after Professor Henry A. Ward, famous naturalist, collector, and proprietor of the Ward's Establishment. Davison had access to the Ward's supply of Fairfield nodules; and his publication not only represents the first piece of mineralogical research on the phosphates from this locality, but helps to establish the dates of earliest mining and the disposition of some of the mined product.

Professor Larsen became interested in the mineralogy of the Fairfield nodules in 1923. His study continued for a number of years. A visit to the mine yielded very meager results, but fortunately the remaining nodules at Ward's were turned over to him for research by George L. English, well-known mineralogist then in charge of the mineral department at the Rochester establishment. The specimens consisted of broken nodules, the interiors partly solid yellow crandallite mixed with interlayered bands of whitish or grayish phosphates, and partly also honeycombed masses of yellow or white crandallite in which small cavities now and then showed tiny sparkling crystals. The material was so exceedingly fine-grained, with numerous intermixed species, except for the rare isolated crystals in cavities, that any investigator was presented with a formidable task simply to sort out discrete particles for optical study and determination under the polarizing microscope. Accurate measurement of the refractive indices was the best way to identify unidentified crystalline substances in those days, before the use of x-ray diffraction techniques in mineralogy. If

the optical and other properties of the particles did not fit those tabulated for all known species in the standard reference works of descriptive mineralogy, then the chances of having a new mineral were promising. Separate crystals having distinctive shapes naturally offered the simplest way to characterize the unique features of a new mineral for comparison with those of similar type, but here such crystals were extremely scarce. It should be added that an identifier always needs to know something about the geological association, origin and chemistry of any unknown mineral studied; in the case of the Fairfield material, secondary phosphates were almost certain to be present.

Professor Larsen was uniquely qualified to tackle the recognition, separation and identification of the new species present in the Fairfield nodules. In 1921 he had brought out his volume of tables (*The microscope determination of the non-opaque minerals;* U. S. Geol. Surv. Bull. 679, 1921) listing the optical properties of all the non-opaque minerals, which was to be expanded in 1934, in collaboration with Harry Berman, into the much larger standard reference work, *Bulletin 848*. He had pioneered in developing the techniques of optical mineralogy in this country and his great work in determining and tabulating for easy reference the optical properties of all non-opaque species known up to 1934, stands as one of the truly great contributions to mineralogical science. He naturally investigated the complex mixtures of the minutely-grained minerals in the Fairfield nodules by determination of their distinctive optical properties. Not only that—he was also a specialist in making heavy-liquid mineral separations. Once the particles of a new species are recognized and determined, a sufficient quantity of them have to be separated in the form of a pure concentrate, usually several hundred milligrams, to make possible a chemical analysis. Without such an analysis, which establishes the chemical formula, no new mineral can be described in the scientific literature and validated as a distinct species.

We may thus by inference follow Larsen's step-by-step investigation of the Fairfield material. He first recognized each new species in finely powdered samples by determination of its distinctive optical properties shown by separate particles. Then he crushed and ground up the source rock to a fine particle size, immersing the powder in heavy liquids of known density which could be altered, by addition of more heavy liquids, toward identifiable higher or lower densities, until the resultant liquid would have just the right specific gravity to allow uniform suspension of the immersed particles without sinking or floating. The associated minerals in the rock, of heavier or lighter densities, and which would sink or float in the same liquid, could then be filtered off by use of separatory funnels until nothing was left except a purified concentrate of the particles of the one mineral having a density identical with that of the liquid.

Larsen's research led to the identification of no less than seven new phosphates from Fairfield, and he achieved separation of enough purified concentrate of each for a chemical analysis. When one considers the techniques used, and the fine-grained nature of the intimately mixed minerals, it is no wonder that several of these species are almost unrecognizable and very little known today. The chemical analyses were made by his friend Dr. Earl V. Shannon, mineral curator and chemist at the U. S. National Museum. The paper describing the new species, also treating the mineralogy of the nodules in general, was published in *The American Mineralogist* in 1930 (Larsen and Shannon, 1930b).

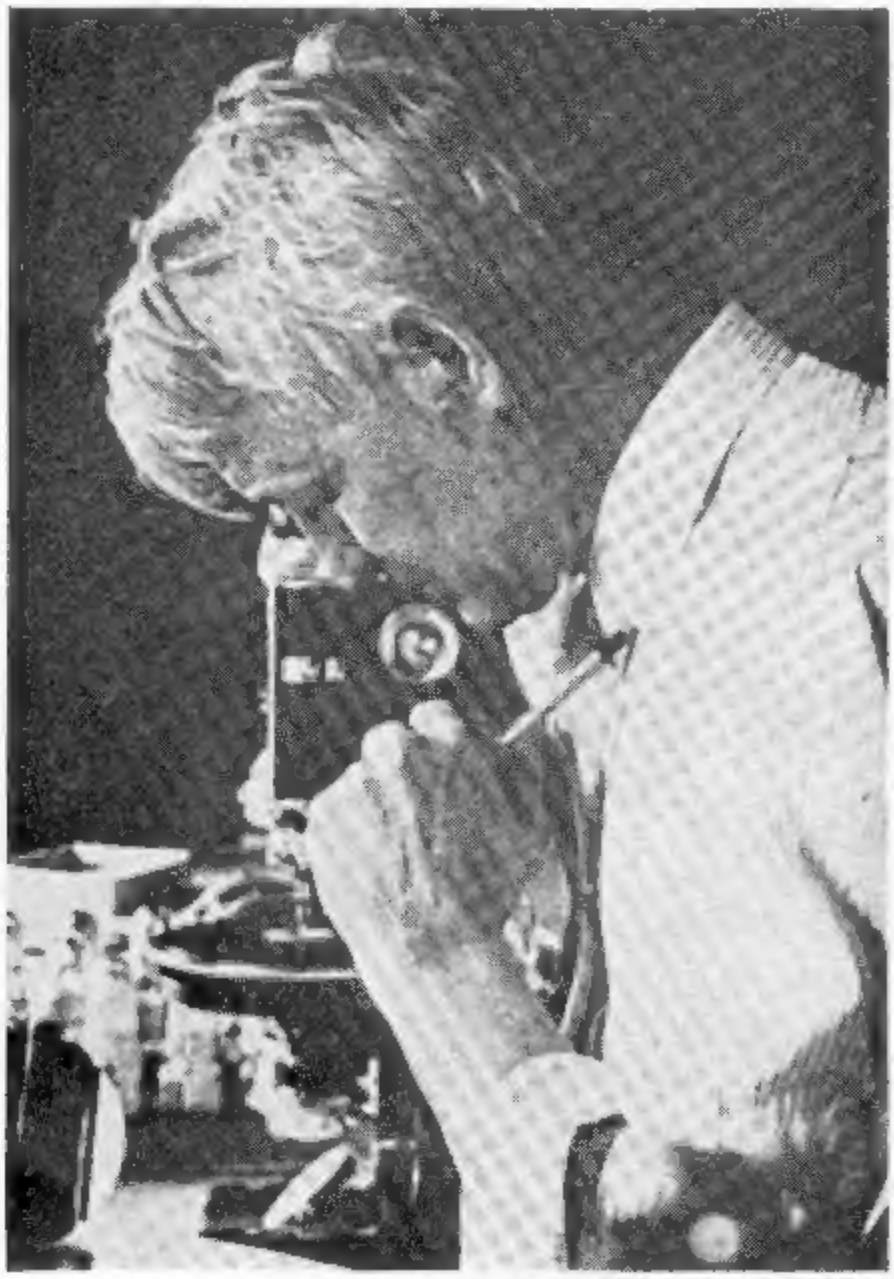
Naming new minerals is a whole story in itself. Where personal names creep in, these can pose problems. Names of those who discover new species, or have something to do with their scientific study or geologic occurrence, are probably the more justifiable of this category. It being understood, according to the rules of

the game, that no describer can name a mineral for himself. Less satisfactory names are of those who have had nothing to do with the newly described species. Famous mineralogists need to be honored; but unfortunately over-eager students or colleagues have had this procedure back-fire on them, and especially on the "honored" recipient, when the supposed new mineral proves later to be a variety of something else already described and gets discredited.

Sometimes a describer of several new species is faced with the problem of coming up with more than one valid name. Professor Larsen had seven new minerals on his hands, and the naming complications proved considerable. Millisite was a good choice, for this gray-white finely-crystalline substance occurring interlayered with bluish wardite in the nodules, paid tribute to the man who first found variscite in Clay Canyon and sent it in to the National Museum for identification. The name Fairfield could not be used, since a fairfieldite already existed. So he temporized with Lehi, the town twenty miles distant where Millis lived, incorporating its name into lehiite to designate a whitish, sometimes snow-white and silky, fibrous mineral that is extremely difficult to recognize today. Appropriate locality names proved increasingly hard to locate, for the potassium-bearing member of the hydroxylapatite group occurring as fibrous masses and tiny hexagonal prisms, was called lewistonite after the far-distant town of Lewiston. Lewiston lies north of Salt Lake City. Davisonite (mistakenly referred to for a time as dennisonite) very properly remembered the man who described wardite; but it was discovered in a whitish, fibrous, crustiform substance even more indefinable today than lehiite. Most elusive of all these new species was the minutely-grained one, intimately mixed with crandallite, that he named deltaite, because of the resemblance of certain of its triangularly-shaped particles to the Greek letter delta. This material, as described and analyzed by Larsen and Shannon, has been found by x-ray study to be identical with a mixture of crandallite plus hydroxylapatite, resulting in the discreditation of the name (Elberty and Greenberg, 1960). One more particularly indefinable mineral present in this material was dehrnite, another member of the hydroxylapatite group that had just been described by Larsen and Shannon as a new species from Dehrn, Germany (Larsen and Shannon, 1930a). Dehrnite differs slightly in its chemical composition from lewistonite; but as its crystalline appearance is the same as that of the latter and the refractive indices of the two species overlap, it is probably impossible to distinguish it from lewistonite by any means except chemical analysis.

Only two of the seven new phosphates from Fairfield displayed distinctive crystal habits. The first was a whitish micaceous-like mineral with a pronounced pearly luster on its thin curving flakes. Larsen named it englishite after George L. English who had supplied the research material and richly deserves the honor for his contributions to American mineralogy and mineral collections. The second species occurred very sparsely as small, glassy, colorless to gray, lath-like crystals perched on variscite within cavities inside a few nodules. Measurements of the crystals with a reflecting goniometer yielded a series of interfacial angles and an axial ratio calculated with respect to the three crystallographic axes, and proved the crystal system to be triclinic. In 1928, Victor Goldschmidt, German crystallographer, and S. G. Gordon, mineral curator at the Philadelphia Academy of Natural Sciences, had published (Goldschmidt and Gordon, Phila. Acad. Nat. Sci., Spec. Publ. No. 2, 1928) their "Crystallographic Tables for the Determination of Minerals." These tables gave key crystallographic data for all well-crystallized minerals known up to that time, which were arranged in such a way as to facilitate identification of any one species by its crystallographic measurements and derived axial ratio. The crystallographic data pertaining to Larsen's seventh species were found to be almost identical with a new phosphate, paravauxite, that Gordon himself had

recently discovered in Bolivia and described. Chemical analysis of the Fairfield phosphate, however, showed it to be a hydrated aluminum phosphate of magnesium, instead of iron as in the case of paravauxite. The two chemically-different minerals were thus proven to be isostructural, with their atomic arrangements the same due to the fact that two atoms contained in them, divalent magnesium and ferrous iron, have similar size and electric charge. These can substitute for each other within the crystal structure common to both minerals to make two chemically-distinct species, one iron-rich and the other magnesium-rich. In view of the isostructural relationship between the two minerals, and in recognition of Gordon's prior description of paravauxite, Larsen named his seventh new phosphate from Fairfield gordonite.



"GOOD FRIEND OF MINERAL COLLECTORS."
FIG. 4. The late Professor Esper S. Larsen, Jr. - as all of his students best remember him. He was responsible for our work at Fairfield. (Photo from Memorial of Esper S. Larsen, Jr., Am. Mineral., 47, 1962, p. 456)

(Part 2 to be continued in next issue)

Feb. 12, 13, 14, 1971
Tucson, Ariz.

Feb. 21, 1971
West Hempstead, L. I., N. Y.

CELESTITE

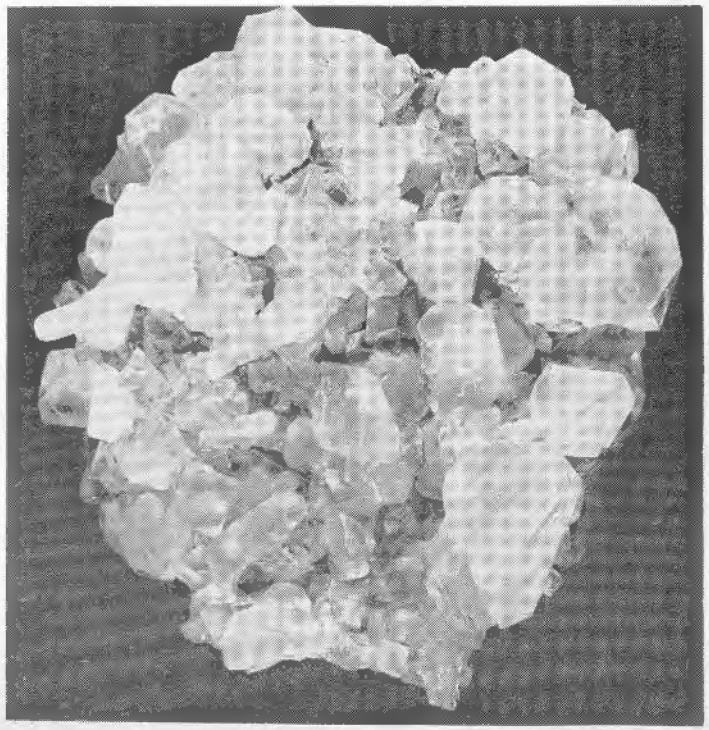
By RICHARD GREEN
336 Caruthers Rd., Tallmadge, Ohio 44278

CELESTITE, an anhydrous sulfate of the Barium group, is present mainly in sedimentary rocks. Limestone of marine origin and sandstone of various geological ages are the major sedimentary deposits in which its occurs. It could have been deposited directly by sea water or precipitated by waters which carried strontium in solution. In these sedimentary formations, it may be present in bedded deposits of gypsum, halite and aragonite. Cavities and veins in dolomites and limestones may contain groups of crystals. It can also occur in other environments such as the exposure along the Credit River in Ontario, Canada, where it is present with sulfur. At Death Valley, California, it is found in evaporate deposits of potassium, salts and borates. The mineral may form with metalliferous ores, as with galena and sohalerite at Condorcet, France. In addition, the sulfate may be present as a ganque mineral in hydrothermal veins or in cavities in basalt. It rarely forms in igneous rocks.

CELESTITE belongs to the orthorhombic crystal system. The crystals are in the dipyramidal class and are quite similar to barite crystals. They are usually thin to thick tabular and less commonly blocky. Sometimes they appear barrel-shaped. The faces are not as smooth as those of barite. Most crystals of CELESTITE do not occur as single isolates but as a profusion of crystals, many of which may be terminated. It can also form as druses or massive in cross-fiber veins. Sometimes the crystals may form in geodes like those of Halls Gap, Kentucky.

CELESTITE is a Strontium Sulfate which could have calcium or barium substituting for strontium. The chemical formula is $SrSO_4$.

The physical properties of CELESTITE are:



Clear xls. of CELESTITE from Scofield, Michigan.

Color—colorless, white, pale blue which is often zoned, reddish, brownish, greenish, and yellowish.

Luster—vitreous to pearly and somewhat greasy on a fresh fracture surface.

Fracture—very brittle: uneven.

Cleavage—good basal and prismatic.

Streak—white.

Hardness—3-3.5.

Sp. Gravity—3.97.

Optical Properties — transparent to translucent.

Tests—causes flame to turn crimson. Slightly soluble in concentrated acid.

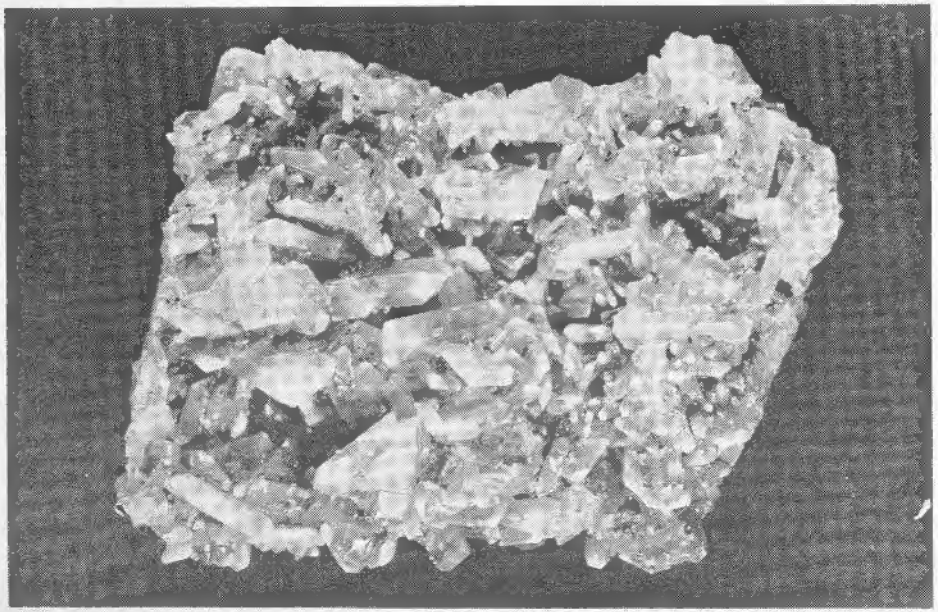
Alteration—to Strontianite. $SrCO_3$.

Associated Minerals — sulfur, calcite, fluorite, araganite, dolomite, barite, gypsum, anhydrate, strontianite and halite.

CELESTITE occurs in many areas of the United States, especially in limestone and dolomite quarries. For example, various localities in western New York, near Rochester and Syracuse in the Lockport Dolomite, are noted for fine blue prismated crystals of $\frac{1}{2}$ to $1\frac{1}{2}$ inches in length which are present in geodes. Also bluish-tinged specimens are found at Chittenango Falls, New York. Besides New York, Ohio provides many sparkling specimens. Clay Center in Ottawa Co. is well-known for thick tabular blue and white crystals which sometime reach $1\frac{1}{4}$ inches in length. Some of the crystals are terminated but most of them are not. Lime City, a locality close to Clay Center, provides exquisite bluish terminated crystals. Those crystals, which were collected five or ten years ago, are barrel-shaped and thick, while the recent ones are tabular. Another locality near Gibbsonburg, Ohio, is known for its bladed crystals of translucent white color which are seldom terminated and are associated with tiny spheres of Strontianite. These crystals fluoresce white and are also phosphorescent. Ida, a small town in Michigan, has contributed large bluish-white crystals from its limestone quarry which is now unfortunately flooded.

At Lampasas, in Lampasas Co., Texas, and in the Mt. Bonnell area near Austin, Travis Co., Texas, large crystals are found. The specimens from Mt. Bonnell are purplish-blue prismatic crystals which are found in geodes. Fine clear to bluish crystals associated with Strontianite in geodes are found in Colemanite in the Calico Hills district, San Bernadino Co., California.

CELESTITE is found as sky-blue crys-



Terminated blue CELESTITE xls. with white tips from Lime City, Ohio.

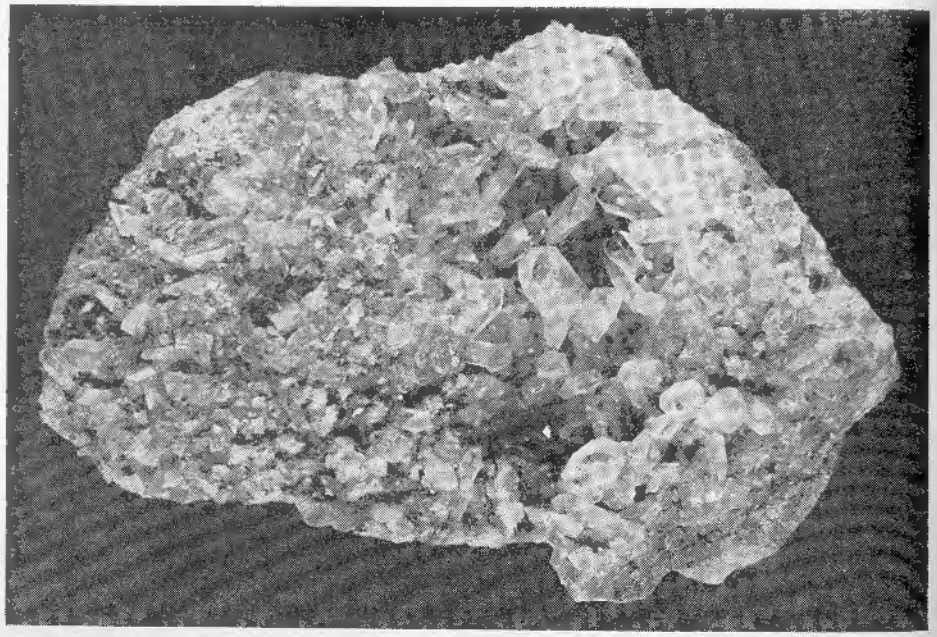
tals of 3/8 inch size near Emery, Emery Co., Utah. In Mineral Co., West Virginia, several miles south of Cumberland, Md., blue pyramidal crystals of 3 inch size are located in cavities of an argilaceous limestone. Also Nashville, Tenn. provides similar cavities containing this sulfate. Kansas contributes a red variety in Brown Co. At Halls Gap, Kentucky, blue terminated crystals may be found in geodes associated with other crystals such as quartz, calcite, fluorite and millerite.

CELESTITE, which is found as opaque radiating masses and as clusters of euhedral crystals are present in brecciated zones of crystalline limestone at Virginia Lake, Ontario, Canada. Several mines near Moira Lake, Ontario, contain pale blue transparent crystals in cavity walls. The crystals occur with fluorite, calcite and barite. Unusually attractive specimens of blue and orange-red blades of CELESTITE appear in between the contact of the Lockport Dolomites and the Whirlpool Sandstones. The exposures are along the Credit River between Cataract and Terra Cotta which is north of Georgetown, Ontario. The crystals are found with gypsum. Another exposure is near Balls Falls on Twenty Mile Creek near Jordan, Ontario. Red crystals occur in the clay beneath Overhanging Rock on the west bank of the creek.

CELESTITE is not only indigenous to the United States and Canada but also appears at Matohuala, San Luis Potose, Mexico, where pale blue crystals which are often etched are located. Gembeek, Germany; Box, Switzerland; Conil, Spain; Garonne, France and the Paris basin at Montmartre in addition produce excellent blue crystals. Fine groups of white crystals associated with gypsum and sulfur are found at the sulfur deposits of Agrigante and Cianeiessa, Sicily. In England, excellent crystals of a clear nature may be found at Aust Terry, Yate and Clifton, near Bristol, Gloucestershire. Also in East Lothian, near the Calton Hill, Edinburgh and near Knaresborough, in Yorkshire.

Although CELESTITE is obviously present in many different areas of the world, the specimens from Ohio, Michigan, New York and Sicily are probably

(Continued on page 687)



Long prismatic CELESTITE xls. from the White Rock Quarry, Clay Center, Ohio.

THE AMATEUR LAPIDARY

HELEN L. MacLEOD
4826 Butterworth Place, N.W., Washington, D.C. 20016

Amateur and professional lapidaries are cordially invited to submit contributions and so make this department of interest to all.

PEARLS AND PEARL PEELING

The name Margarite means pearl, so the pearly oyster is called Margaritifera. Pearls were once used as crown jewels instead of diamonds, as diamonds were too scarce for even kings to have enough. This lasted thru the time of Queen Elizabeth the First. Diamonds came in plentifully to Louis the Fourteenth. Tavernier brought them.

A gem is supposed to be durable, yet pearl is only 2½ hardness. The lustre of pearl is quite mysterious. It is like satin, yet with suggestions of changing colors. The lustre is caused by the structure: thin films and scales that are so fine they cause diffraction and interference. A great roll of cellophane looks a little pearly. Layers again.

If you read a lot about pearls, you may run across mention of Pearl Peeling and that mysterious expert, the Pearl Peeler.

This occurs oftenest in English references. It conjures up pictures of some medieval type with slender needles and knives and unknown solvents.

The pearl peeler was an expert, unquestionably. He must have had great patience (to work slowly). He also had judgment and experience to know when to peel and when to let well enough alone. And how did he peel?

The answer is not as vital as it once was: because the layers on many culture pearls are too thin to stand peeling.

The art was primarily of use in the days of natural pearls, particularly when large and potentially valuable.

Needless to say, machinery was not employed.

The pearl is very soft.

And how do you peel?

The following is an actual, recent occurrence:

A jeweler was showing his friend (A. C. Bonanno) an enormous real pearl. Its condition was deplorable: staining warts, etch marks. "What have you got to lose?" said A. C. Bonanno.

His suggestion was very simple. A piece of chamois on a table. Moist Linde A paste. Scrub the pearl around and inspect frequently. Luck was with them. The inside was good and in a short time the big pearl was worth hundreds of dollars.

THE BORON GEMS

It is remarkable how many gemstones contain the little known element Boron, and how rare and beautiful many of them are. A display containing some or all of them would get quite a lot of attention. Why so many?

Boron is a strange hippy type element. It forms compounds with metals in all sorts of different proportions, almost completely ignoring conventional valence. Boron Nitride was synthecized, it was maybe harder than diamond although the dearth of subsequent details is great and commercial applications delay.

Be that as it may, Boron Nitride is just one example of Boron combining with the noble "inert" gases that nothing combines with, they taught us in school.

Boron too, is playing with forbidden symmetry, although regretably only a small scale. The inflexible dictum, "Three can be no five-fold symmetry" refers, hopefully to when all the atoms are the same size . . . In making a tile floor, if all tiles are (identical) regular polygons, you can have triangles, you can have hexagons or you can have squares. But if you combine more than one kind of regular polygon, keeping the sides the same length so they will fit . . .

LARGE EXTINCT ANIMALS, PRACTICALLY UNKNOWN

By HERMAN KRAEGE
Rt. #1, Whitewater, Wisc. 53190

Since I have been a collector of fossils, rocks and minerals for 20 years, and do have a fairly large collection, I have learned quite a bit about them.

But it is not about my own collection that I write now. I want to write about the science of fossils, paleontology, and of the problems that sometimes face the paleontologists, and about new discoveries that are being made.

Two large animals are known to have existed at the time of the mammoths and Mastodons, and became extinct at about the same time.

Was the knowledge of these two animals so over-shadowed by the two giants that the existence of them was completely over-looked? The two animals, the so-called Woodland Musk-Oxen, generic name, Symbos cavifrons, and the Bootherium bombifrons.

Finds have been made of the Musk-Oxen as follows: Locality 1—Washtenaw County, Michigan, half mile Northwest of Manchester: Locality 2— Hillsdale County, Michigan, 2 miles South of Hillsdale: Locality 3—Van Buren County, Michigan, half mile Northeast of Paw Paw: Locality 4— Kalamazoo County, Michigan, 4 miles Southeast of Climax: Locality 5— Kalamazoo County, Michigan, half mile South of Scotts: Locality 6—St. Joseph County, Michigan, 3 miles South of White Pigeon.

Bootherium discoveries were made as follows: Bootherium Sargenti, Muskegon County, Michigan, 3 miles Northeast of Mooreland. Bootherium bombifrons, Big Bone Lick, Kentucky. A find in Douglas County, Nebraska, 1931, and one from Frankstown Cave, Belair County, Pennsylvania.

After thorough examination and discussion, it was believed that some of the finds listed as Bootherium Sargenti of Michigan, and the Frankstown Cave, Pennsylvania find, could have been females of Symbos cavifrons, but that Bootherium bombifrons from Kentucky is definitely a distinct species.

I have no other information to indicate the identity of the Nebraska specimen. This is rather unfortunate because I received a number of teeth that a man in Nebraska extracted from what he believed to be the skull of a Buffalo, and I now find that they compare perfectly with the teeth of Symbos cavifrons as shown in the Journal of Paleontology, Volume 38, No. 5, September 1964, University of Michigan.

These Musk-Oxen had no affinity with the Musk-Oxen of the far North, which are animals more of the sheep order. The Woodland Musk-Oxen were taller and more slender than the buffalo and strictly of the nature and structure of a bovine animal.

Much less is known of the Bootherium.

CELESTITE

(Continued from page 678)

the most beautiful. Photographs taken by a very close friend of mine and an excellent photographer, Richard Johnson, clearly show this. However, in recent years, these crystals from the above localities are becoming harder to obtain because of the closing of collecting localities to rockhounds and the scarcity of material. This is not entirely true of the specimens from Sicily. They are still relatively available at this time.

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MID-HUDSON NEWS

The Mid-Hudson Valley Gem and Mineral Society's first Gem and Mineral show was a great success with over one thousand in attendance. The Mid-Hudson Society wishes to thank all the advertising media for their help and cooperation. The newspapers, radio, magazines and our 75 business establishments, as well as the Beacon Kiwanis Club, where the Society representatives were guests.

The show committee wishes to especially thank the Mattawan Club of New Jersey, the Danbury Club of Connecticut, Rocks and Minerals Magazine and the Eastern Federation for their ideas, suggestions and general good will. All these with the directions of the mineral dealers introduced the hobby of rock collecting to many people who only were familiar with the rocks in their driveway. It is hoped we have taught young people to collect rocks and not throw them.

The Judging was carried out under the rules of the Eastern Federation of Mineralogical Societies. The Judges were Mrs. Alice Kraissl, Mrs. Olivia De Laney, Dr. Russell H. Waines and Mr. Harold Zimmerman. They were fair and gracious with their inspection of all exhibits and most helpful to the younger collectors with many helpful hints and suggestions for future exhibits. The swap area was well attended and the lectures so popular three of them had to be repeated.

Among the exhibits, one of the most popular was Mr. Ewald Gertsmann's Fluorescent Minerals. Many of the club exhibits made the "Catlin Case" or the Litchfield Showcase of the Litchfield Club of Connecticut, for their exhibits.

—Gordon L. Kenney
24 Wodell St.
Beacon, N. Y. 12508

SHOP TIP ON SAWING

Courtesy of The Rock Vein

I have found over the years that some peoples have trouble producing a square cut in their rock saws, the type required for cutting blocks for spheres, book ends, etc. I have developed the following procedure which usually produces very good results.

Study the piece carefully before starting to cut. Figure just how big a piece you want for the finished product. Then make your first cut. Now remove the pieces from the vise and turn your first cut side up. It will remain in this position for the next four cuts, only turning it from side to side. Before making your second and following cuts, place a level on the first cut, keeping the material in a level as you tighten your vise. If your vise and arbor are true, your second cut should be square with the first cut. Before making the third and following cuts, use a carpenter's square to mark them out. Line this mark with your blade, keeping the top level. Use this procedure for all following cuts. The size of the block is determined in your fourth cut. Then it becomes necessary to use this measurement in all succeeding cuts.

The most important things to remember after making your first cut are to have your material level in the vise by using a good reliable level, and to keep your lines, made by use of a good square, in line with your saw blades. Last, but not least, be accurate in your measurements . . . . By Charlie Schafer via the Rock-A-Teer.

PASS ON YOUR EXTRA SPECIMENS
TO A STUDENT OR A SCHOOL.